

CALIBRATION STANDARD REQUIREMENT

FOR A

METER CALIBRATOR AMPLIFIER

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PROCUREMENT PACKAGE

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Code MS-33
Corona, CA 91718-5000

July 1995
Encl (1)

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METER CALIBRATOR AMPLIFIER

1. SCOPE

1.1 Scope. This requirement defines the mechanical and electrical performance requirements for a Meter Calibrator Amplifier, hereinafter referred to as the MCA. The MCA provides General Purpose Interface Bus (GP) capabilities in accordance with IEEE-STD-488. The MCA is intended for use shipboard and shorebased Navy personnel in association with calibration equipment used to calibrate multimeters. The MCA shall extend the AC voltage, DC current and AC current ranges of the Fluke 5700A/AN Calibrators presently used as Navy calibration standards. All functions of the MCA, including operation and calibration, shall be controlled by the 5700A/AN Calibrator. The MCA shall have its own binding post output terminals for the 11-ampere AC and 11-ampere DC current ranges. The generated high-voltage AC shall be routed back through the 5700A/AN and shall be available at the 5700A/AN output.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military requirement, Test Equipment for use with Electrical and Electronic Equipment, General specification for," and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this requirement.

3. REQUIREMENTS

3.1 General. The MCA shall conform to the Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy shipboard and shorebased equipment as modified below.

3.1.1 Design and Construction. The MCA design and construction shall meet the requirements of MIL-T-28800 for Type III equipment.

3.1.2 Power requirements. The MCA shall operate from a source of 103.5V to 126.5V at 60Hz (5% single phase input power as specified in MIL-T-28800).

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line, defined by MIL-T-28777, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800 with a 6 foot (1.8 m) minimum length of cord.

3.1.3 Dimension and Weight. Maximum dimensions shall not exceed 17 inches (43.2 cm) in width, 5.25 inches (13.3 cm) in height, and 25 inches (63.5 cm) in depth. The weight shall not exceed 70 pounds (32 Kg).

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium

batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposal. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The MCA shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The MCA shall meet the uncertainty specifications given herein under the conditions listed below:

	<u>Temperature(°C)</u>	<u>Relative Humidity(%)</u>
Operating	10 to 30 30 to 40	95 75
Non-operating	-40 to 70	Not controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE02, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The MCA shall have an 85% or greater probability of remaining within tolerances of all requirements at the end of a 12 month period.

3.4 Maintainability. The MCA shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The oscillator shall provide the following capabilities. Unless otherwise indicated, all performance requirements shall be met following a 30 minute warm-up period, over the temperature range +10°C to +40°C and with line voltage variation of (10%.

3.5.1 AC Voltage. The MCA shall boost the AC Voltage of the 5700A/AN to provide a higher volt-hertz product capability. The MCA generated AC voltage shall be routed out the 5700A/AN output binding post so as to appear transparent to the user.

3.5.1.1 AC Voltage Specifications. The absolute uncertainty of the MCA-generated AC voltage shall not exceed the following specifications when operating within (5°C from the calibration temperature.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output + mV)</u>
1100 V	40 Hz to 1 kHz	90 + 4
	1 kHz to 20 kHz	165 + 6
	20 kHz to 30 kHz	600 + 11
750 V	30 kHz to 50 kHz	600 + 11
	50 kHz to 100 kHz	2300 + 45

3.5.1.2 Amplitude Resolution. The MCA output shall have 1 mV resolution.

3.5.1.3 Frequency Requirements.

3.5.1.3.1 Frequency Range. The MCA frequency range shall be 40 Hz to 100 kHz up to 750 V, and 40 Hz to 30 kHz up to 1100V.

3.5.1.3.2 Frequency Uncertainty. The frequency uncertainty shall be (0.01% or better.

3.5.1.3.3 Frequency Resolution. The frequency resolution shall be better than 0.009% for any frequency.

3.5.1.4 Remote Sensing. Four-wire remote sensing shall be provided. The 5700A/AN shall have control of the internal or external sensing condition and indicate the sense status on the front panel. When set for internal sense, required connections shall be made on the 5700A/AN front panel.

3.5.1.5 Load Capacity. The MCA shall meet the uncertainty specifications in 3.5.1.1 to the following load requirements.

<u>Maximum Output</u>	<u>Frequency</u>	<u>Maximum Current</u>	<u>Load Limits</u>
1100 V	40 Hz to 5 kHz	50 mA	300 pF
	5 kHz to 30 kHz	70 mA	300 pF
	30 kHz to 100 kHz	70 mA	150 pF

3.5.1.6 Load Regulation. The MCA shall be capable of driving capacitive loads up to 1000 pF. The MCA uncertainty during loads of 1000 pF shall be no more than the uncertainty specifications in 3.5.1.1 plus the following load regulation adder.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output + mV)</u>
1100 V	40 Hz to 1 kHz	10 + 1
	1 kHz to 20 kHz	90 + 6
	20 kHz to 50 kHz	275 + 11
	50 kHz to 100 kHz	500 + 30

3.5.1.7 Temperature Coefficient. The MCA temperature coefficient, when it is operating outside (5(C of the calibration temperature, shall not exceed the following from 10(C to 40(C.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output)/ (C</u>
1100 V	40 Hz to 1 kHz	5
	1 kHz to 20 kHz	5
	20 kHz to 50 kHz	10
	50 kHz to 100 kHz	30

3.5.1.8 Harmonic Distortion and Noise. The MCA harmonic distortion and noise (including random spikes), when measured in a 10 Hz to 10 MHz bandwidth, shall not exceed the following.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((% of output)</u>	
1100 V	40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	<u>150 pF 1000 pF</u>	
		0.07	0.07
		0.10	0.15
		0.30	0.30
		0.40	0.40

3.5.1.9 Short Term Stability. The 24 hour instability of the MCA when operating within 1°C of the calibration temperature shall not exceed the following.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output + mV)</u>
1100 V	40 Hz to 1 kHz	10 + .5
	1 kHz to 20 kHz	15 + 2
	20 kHz to 50 kHz	40 + 2
	50 kHz to 100 kHz	130 + 2

3.5.1.10 Settling Time. The MCA settling time to full accuracy shall not exceed the following.

<u>Frequency</u>	<u>Settling Time (seconds)</u>
(120 Hz	11
120 Hz to 120 kHz	9
(120 kHz	6

Note: An additional 1 second is allowed for amplitude or frequency range changes.

3.5.1.11 Guard. The MCA AC section shall be guarded through the 5700A/AN Calibrator. The 5700A/AN Calibrator shall contain the terminal which is connected to the guard.

3.5.2 DC Current. The MCA shall be capable of extending the DC current capability of the 5700A/AN Calibrator to 11 A. The MCA shall have a range of 0 to 11 A with the output current present at the MCA output binding posts.

3.5.2.1 DC Current Uncertainty. When operating within 5°C of the calibration temp, the absolute uncertainty of the MCA 11-A DC current range shall be no more than $((360 \text{ ppm of output} + 480 \mu\text{A})$.

3.5.2.2 Resolution. The MCA 11 A DC current range shall have a resolution of 10 μA .

3.5.2.3 Short Term Stability. The 24 hour DC current instability of the MCA when operating within 1°C of the calibration temperature shall not exceed $((100 \text{ ppm of output} + 130 \mu\text{A})$.

3.5.2.4 Temperature Coefficient. The MCA DC current temperature-coefficient adder, for 10°C to 40°C , when operating outside 5°C of the calibration temperature, shall not exceed $((20 \text{ ppm of output} + 75 \mu\text{A}) / ^{\circ}\text{C}$.

3.5.2.5 Compliance Limit. The MCA DC current shall meet the uncertainty specifications listed in 3.5.2.1 to a compliance voltage of 4 V.

3.5.2.6 Noise. The MCA DC current noise shall not exceed the following.

<u>Bandwidth</u>	<u>Noise</u>
0.1 Hz to 10 Hz	$(15 \text{ ppm of output} + 70 \mu\text{A})_{\text{pk-pk}}$
10 Hz to 10 kHz	175 μArms

3.5.2.7 Settling Time. The MCA DC current maximum settling time to full accuracy shall be 6 seconds, + 1 second for range or polarity changes.

3.5.3 AC Current. The MCA shall be capable of extending the AC current capability of the 5700A/AN Calibrator to 11 A. The MCA shall have a range of 1 A to 11 A with the output current present at the MCA output binding posts.

3.5.3.1 AC Current Uncertainty. The absolute uncertainty of the MCA 11 A AC current range shall meet the following requirements.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output + μA)</u>
11 A	40 Hz to 1 kHz	460 + 170
	1 kHz to 5 kHz	950 + 380
	5 kHz to 10 kHz	3600 + 750

3.5.3.2 Resolution. The MCA 11 A AC current range shall have a resolution of 100 μ A.

3.5.3.3 Short Term Stability. The 24 hour AC-current instability of the MCA, when operating within 10°C of the calibration temp, shall not exceed the following.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output + μA)</u>
11 A	40 Hz to 1 kHz	75 + 100
	1 kHz to 5 kHz	100 + 150
	5 kHz to 10 kHz	200 + 300

3.5.3.4 Temperature Coefficient. The MCA AC-current temperature coefficient adder, for 10°C to 40°C, when operating outside 5°C of the calibration temperature, shall not exceed the following.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((ppm of output + μA)/ °C)</u>
11 A	40 Hz to 1 kHz	30 + 75
	1 kHz to 5 kHz	50 + 75
	5 kHz to 10 kHz	100 + 75

3.5.3.5 Compliance Limit. The MCA AC current shall meet the uncertainty specifications listed in 3.5.3.1 to a compliance voltage of 3 V.

3.5.3.6 Distortion and Noise. The MCA AC current total distortion and noise (including random spikes) when measured within a 10 Hz to 50 kHz bandwidth shall not exceed the following using a resistive load within the rated compliance voltage limit.

<u>Maximum Output</u>	<u>Frequency</u>	<u>((% of output)</u>
11 A	40 Hz to 1 kHz	.05
	1 kHz to 5 kHz	.12
	5 kHz to 10 kHz	.5

3.5.3.7 Settling Time. The MCA AC current maximum settling time to full accuracy shall be 6 seconds, + 1 second for range or polarity changes.

3.6 Operating Requirements. The MCA shall provide the following capabilities via the controls of the 5700A/AN Calibrator.

3.6.1 Front Panel Control Requirements. All modes and functions shall be operable using front panel controls. The location and labeling of indicator controls and switches shall provide for maximum clarity and easily understood operation without reference to tables, charts or flow diagrams.

3.6.2 Standby/Operate. A STANDBY/OPERATE switch shall be provided.

3.6.3 Error Correction. During calibration, the MCA shall provide the capability to accept and store corrections for all measurement deviations from nominal conditions. The MCA shall meet all the specified performance specifications without requiring additional entry of any calibration factor or other correction data.

3.6.4 Self Test. The self test shall determine operational readiness and isolate faulty modules via the controls and indicators of the 5700A/AN Calibrator.

3.6.4.1 Display. If the self test fails, the display shall indicate the nature of the failure and provide directions for diagnostic action. The MCA front panel shall indicate when it is in voltage mode, current mode, overload fault and when the MCA to 5700A/AN interface cable is disconnected.

3.7 Digital Interface. The MCA shall provide a digital interface via the 5700A/AN calibrator as specified in MIL-T-28800 and IEEE-488 General Purpose Interface Bus (GPIB).

3.7.1 Remote Programming Requirements. All modes, functions, and inputs/outputs of the MCA shall be remotely programmable over the IEEE-488 General Purpose Interface Bus (GPIB) via the 5700A/AN Calibrator.

3.7.2 GPIB Capabilities. The following IEEE-488 capabilities shall be provided via the 5700A/AN Calibrator.

T6 or TE - Talker,
L4 or LE4 - Listener,
SR1 - Service request,

3.7.3 Status Register Access Requirements. Access to status register via the 5700A/AN Calibrator shall be available via the IEEE-488 bus to ascertain MCA mode, range and other operational and error status.

3.7.4 Bus String Terminator Requirements. Terminators for a string of bus commands shall be a carriage return followed by line feed and EOI signal.

3.7.5 Bus Address Switch. Address must be selectable without removing any covers.

3.7.6 Bus Error Handling Requirements. Bus error reporting and recovery conventions shall be fully described in the Operation and Maintenance Manual.

3.7.7 Compatibility. The MCA, when used as part of an automated system, shall be capable of automatically energizing and/or calibrating applicable test instruments and measurement systems that are IEEE-488 bus configured. The MCA shall be compatible with the Fluke 1722A and 1722A/AP Instrument Controllers via the 5700A/AN Calibrator..

3.8 Accessories. The following accessories shall be provided with each MCA.

3.8.1 Power Cable. One power cable in accordance with MIL-T-28800, with minimum length of 6 feet (1.8 m).

3.8.2 Interface Cable. One interface cable for interfacing the MCA to the 5700A/AN Calibrator.

3.9 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.9.1 Calibration Procedure. A calibration procedure in accordance with MIL-M-38793 shall be provided.